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From Seed to Product: An Interdisciplinary Approach to Linking the Agriculture and Industrial Stages of Cotton through Water Research

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From Seed to Product: An Interdisciplinary Approach to Linking the Agriculture and Industrial Stages of Cotton through Water Research

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Worldwide demand, production, and use of textile and apparel products, fueled by a global industry valued at $3 trillion, affects climate, creates substantial waste, and depletes water resources (Fletcher & Grose, 2012). Cotton has a particular impact on water use and water pollution in part due to its scale of production: cotton fiber makes up 40% of worldwide textile production, accounts for 7% of all irrigation water used globally, and $2 billion dollars' worth of chemicals are sprayed on the world's cotton crops every year, half of which are considered toxic and hazardous (Fletcher & Grose, 2012; Siebert & Doll, 2010; Chapagain, Hockstra, Savenije, & Gautam, 2006).

Water impacts of cotton production occur from agricultural (field) to industrial stage (processing seed cotton into products) (figure 1). Cotton is a needy, thirsty crop, and over 50% of the global cotton fields are irrigated (Fletcher & Grose, 2012), contributing to water depletion problems around the world. In Central Asia, for example, the Aral Sea has lost approximately 80% of its water volume due to inflowing rivers being diverted for the irrigation of crops. While over three quarters of water use occurs in farming, manufacturing use is significant when occurring in areas of water scarcity (Maxwell, McAndrew, & Ryan, 2015). Furthermore, in countries with little environmental regulation, where most textile and apparel production occurs, wastewater from wet processing and finishing processes is often discharged into local rivers, contaminating them with toxic, bio-accumulative, and carcinogenic chemicals (Fletcher & Grose, 2012; Maxwell, McAndrew, & Ryan, 2015).

Figure 1. Water resources and water pollution from cotton seed to product use.

Compounding the complexity of cotton production is a segregated supply chain with lack of transparency among stages. Improving water resource management along the cotton supply chain requires system interventions beyond any one technological improvement or one company/organization acting alone. It also requires an understanding of the spatial heterogeneity of cotton supply chains overlaid with areas of water scarcity and water contamination.

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The apparel industry has a tremendous impact on water, yet unlike food systems, where consumer interest in sustainability is growing, it is difficult for the everyday consumer to understand the nuances of sustainable clothing and there has been little growth in sustainability labels and claims. Water use and pollution needs to be evaluated throughout the clothing supply chain to identify leverage points to reduce water impacts and design new processes to integrate water sustainability into production industry-wide.

This is groundbreaking because of the disjointed nature of the clothing supply chain, where the apparel industry focuses almost exclusively at the post production end, with limited knowledge of innovations in agriculture and crop production. Linking the two ends of the supply chain, including spatial context and production requirements, will help stakeholders manage their water impacts in a holistic manner with substantial potential to improve water resources.

An interdisciplinary team that forms a unique connection between water-focused research on crop production, commodity and supply-chain expertise, and deep knowledge of design and production processes in apparel is crucial to creating impactful research and lasting change in the industry. Because the apparel industry has substantial impacts on water resources, identifying leverage points for reducing water use and pollution by improving design and production processes will significantly improve water resources, especially for those where global production facilities are located, such as China and India. Our goal is to mainstream improved processes industry-wide so that every consumer can benefit. The U.S., and the globe will benefit from more efficient and cleaner water practices, as well as sustainable transparency throughout the cotton supply chain.

The following interdisciplinary research is proposed to reduce water resources and water pollution across the cotton supply chain: We aim **to quantify water use and pollution in the cotton apparel supply chain under spatially explicit supply chain scenarios to identify leverage points to reduce impact on water resources.** To do so, we will evaluate the range of water use and pollution along the complete supply chain of a ubiquitous item of apparel – the cotton t-shirt – integrating information about crop production, textile manufacturing, product design and manufacturing, and consumer use. We will 1) quantify the extent of variation in water use at each stage of production and 2) investigate sources of variation, which may include types of cotton, production practices, location, and facility characteristics. We will then 3) assess how cotton agriculture, production, and design practices can be improved to reduce impacts on water resources. To instigate lasting change across the industry, we will 4) evaluate methods of communication with stakeholders along the cotton supply chain and 5) assess how the value of water, particularly reductions in treatment costs, can be leveraged to initiate process change.

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